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United States Department of Agriculture,

BUREAU OF BIOLOGICAL SURVEY.

HENRY W. HENSHAW, Chief of Bureau.

DIRECTIONS FOR FIELD WORK OF THE ASSISTANTS OF THE BIOLOGICAL SURVEY.

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The following directions are intended to apply to the general field work of the Biological Survey in connection with the work relating to the geographic distribution of birds and mammals and to supplement detailed instructions for special areas. They will obviate the necessity of repetition in issuing field instructions and will aid in securing uniformity of methods and accuracy of results.

OUTFIT.

Field naturalists should be provided with such of the following articles as their work requires:

Letter of authorization.	Camp bags.
Letter of instructions.	Collecting chest, with trays.
Transportation orders.	Ammunition.
Vouchers, form No. 4.	Traps.
Subvouchers, form No. 4a.	Tow.
Fiscal regulations.	Cotton.
Telegraph blanks and identification cards.	Arsenic.
Maps.	Alum.
List of genera of mammals.	Formalin.
Catalogues for mammals, birds, and plants.	Thread.
Notebooks.	Needles.
Field journal.	Pins.
Labels.	Wire (assorted sizes on spools).
Skull tags.	Plant press (driers and papers).
Stomach cards.	Report paper.
Aneroid.	Letterheads.
Camera.	Scratch pads.
Films or plates.	Official envelopes (2 sizes).
Steel tape.	Blotters.
Dividers.	Carbon ink.
Stuffing forceps.	Fountain-pen ink.
Scalpels (2 sizes).	Pens.
Scissors.	Penholders.
Cutting pliers.	Pencils (black and colored).
File.	Twine.
Whetstone.	Rubber bands.
Tent.	

In addition to the supplies furnished by this bureau, each field man is expected to outfit himself with such of the following articles as may be required by the character of his work:

- Shotgun (preferably 20-gauge).
- Auxiliary barrel (32 caliber, center fire).
- Fountain pen.
- Canvas bag (waterproof, for clothing).
- Telescope or hand bag.
- Steamer trunk or heavy telescope for work along railroads.
- Sleeping bag or blankets if for camp trip.
- Clothing suitable for the trip.

CLOTHING.

Clothing should be varied in accordance with climatic conditions, but there should be provided a strong outer suit of khaki, flannel, or corduroy, a soft hat, strong and comfortable but not too heavy walking shoes, several flannel or other soft shirts, a change of heavy and a change of light underwear, stockings, handkerchiefs, and generally a sweater. An ordinary traveling suit can be worn to and from the field and kept for use when a change of clothing is necessary. A towel, soap, toothbrush, and comb should always be carried. A box of one-eighth-inch round-headed screws should be provided, and, when needed, a row put around the edges of the soles and heels of the walking shoes for hobnails. With a hammer, nail, and screw-driver the shoes may be easily armed for rough work or climbing.

BEDDING.

For a camp bed a sleeping bag of several woolen inner blankets and a waterproof outer canvas is preferred by many. A cheaper, simpler, and equally comfortable bed may be made from one woolen blanket and two cotton comfortables sewed into the form of a sleeping bag or left open along one side and either covered with a light waterproof outer bag or folded in an 8-by-8-foot light waterproof canvas. It is often desirable to pin the bedding together with large blanket pins, instead of sewing in a bag. By treating a piece of khaki or closely woven drilling with paraffin or lanum it becomes perfectly waterproof and is much lighter than duck. Tanalite and oiled balloon silk are the lightest and best waterproof coverings. An outfit should be as light as possible.

LOCATION FOR WORK.

For field work undertaken without a camp outfit it is generally best to locate in a small town or on a ranch, where birds and mammals are to be found conveniently near. But where it is possible to hire a man with a team, wagon, and camp outfit, there are great

advantages in being able to camp where the work is to be carried on. In a locality where a general collection is desired and there is time for thorough work, every kind of ground likely to harbor different species should be hunted and trapped over, especially different elevations if varying sufficiently to include different zones.

COLLECTING SPECIMENS.

Specimens of certain species of mammals, birds, reptiles, and plants are important from each locality. The experienced naturalist knows most of the species, understands which are common and which are rare, knows if they are out of the range ascribed to them, and often recognizes variations which make the collection of a good series of specimens desirable. The inexperienced collector must be guided mainly by detailed instructions, but specimens should be collected of such species as can not be identified in the field, whether mentioned in the instructions or not.

TYPE LOCALITIES.

It is always important to secure a good series of specimens in the exact locality from which a species was first described, so as to show not only the specific characters but as much as possible of variation of the species with season, age, and sex. A list of type localities for the section to be worked is of great assistance.

PREPARATION OF SPECIMENS.

The Biological Survey field assistants must be experienced collectors, able to secure representative series of mammals, birds, and reptiles and make them into good specimens. As, however, methods differ among even skilled collectors, and as uniformity in skins as well as in measurements and methods of work is important, a few general directions for preparing specimens are here given.

In skinning birds and mammals avoid stretching the skins, as once stretched they can not be reduced to their original size and form when stuffed. In the case of fat specimens use plenty of corn meal or sand to absorb the grease, and thoroughly clean the skin before stuffing.

For stuffing use cotton for mice, fine tow for chipmunks, gophers, and squirrels, excelsior for rabbits and woodchucks, and the same materials for corresponding sizes of birds. In general, mammals larger than large squirrels should not be stuffed in the field, but salted and dried. In exceptional cases large birds and even smaller mammals may be salted.

Skins should be stuffed to approximately the natural size of the animal slightly flattened in the case of small species and much

flattened in larger species. A mouse skin should be slightly depressed, a squirrel skin scarcely half as high as wide, and a skunk or coon skin a quarter or a third as high as wide. Large bird skins can not be so much flattened on account of the wings. (See fig. 1.)

Mammal skins should be of equal width and equal height throughout their whole length, so they will remain straight and lie close together in trays. The tails should be straight with the median line of the belly, and both front and hind feet should be pinned to the tray, soles down, and dried flat and straight. It is often necessary to compare the length of feet in different specimens, and this can be done only when the feet are dried in proper form. In the case of most mammal skins the lips should be sewed together and the head given a natural form except for the necessary degree of flattening. In skins made too narrow and slender, or too wide and flat, the



FIG. 1.—Sample of well-made bird skin.

markings and colors are distorted and the specimens are not fit for comparison with properly made skins.¹ (See fig. 2.)

In labeling specimens the locality and all other data entered on the labels should be neatly printed in carbon ink.

The collector's catalogue number should be placed across the back of the label at the end, the three measurements next to it, and the altitude, special locality, or any explanatory notes, next to these. The locality on the front of the label should agree exactly with that in the locality column of the catalogue. The skull tag should bear the collector's number and initials. (See fig. 3.)

The nearest and best known locality, as designated on current maps, should be on the face of the label, and the exact locality, in many cases with distance and direction, on the back.

Every precaution should be taken to prevent transposition of labels or tags.

Birds should be examined for sex, and mammals in the breeding season for embryos.

Drying skulls is sometimes difficult in hot or humid weather. The brains and thick flesh should be removed and the skulls strung

¹ Full directions for making skins of small mammals are given in Circular No. 11; for preparing large skins and skulls in Circular No. 49, Biological Survey, Dept. of Agriculture.

on a wire through the loops of the tags and hung in the sun and wind until thoroughly dry. Do not put arsenic, alum, salt, or other preservative on skulls. Should they become infested with maggots these may be killed with hot water.

Bird and mammal skins when thoroughly dry should be wrapped in cotton or soft paper and snugly packed in light, strong, wooden boxes for shipping. As many as possible should be sent by mail in packages weighing not over 4 pounds. The larger specimens should go by express in boxes as light as can be safely used.

Skulls when thoroughly dried can be shipped by mail in tin cans or tight boxes, carefully wrapped, or large skulls singly, well wrapped and sewed up in gunny sacking.

Undried salted skins may be shipped by mail for short distances, or for long distances in cool weather, but great care must be used that they be sufficiently dry so that the moisture will not penetrate wrappers in the mail. If possible, salted skins should be thoroughly dried before shipping. If the tails and feet are properly skinned and salted and the skins are allowed to dry partially they can be safely sent wrapped with dry tow or a number of thicknesses of newspapers.

PRESERVING IN FORMALIN.

Reptiles, batrachians, some bats, mammal embryos, and a specimen of each small mammal should be preserved in formalin. Batrachians, young reptiles, embryos, and such delicate forms should be preserved in a 4 per cent solution of commercial formalin; snakes, lizards, and mammals require a 6 to 8 per cent solution. In hot weather the solution needs to be stronger than in cool. All specimens should be cut open in one or more places along the belly so that the formalin can enter the abdominal cavity. Large snakes should be cut open at intervals all along the belly, and both snakes and large lizards should have incisions along the under side of the tail back of the anus.

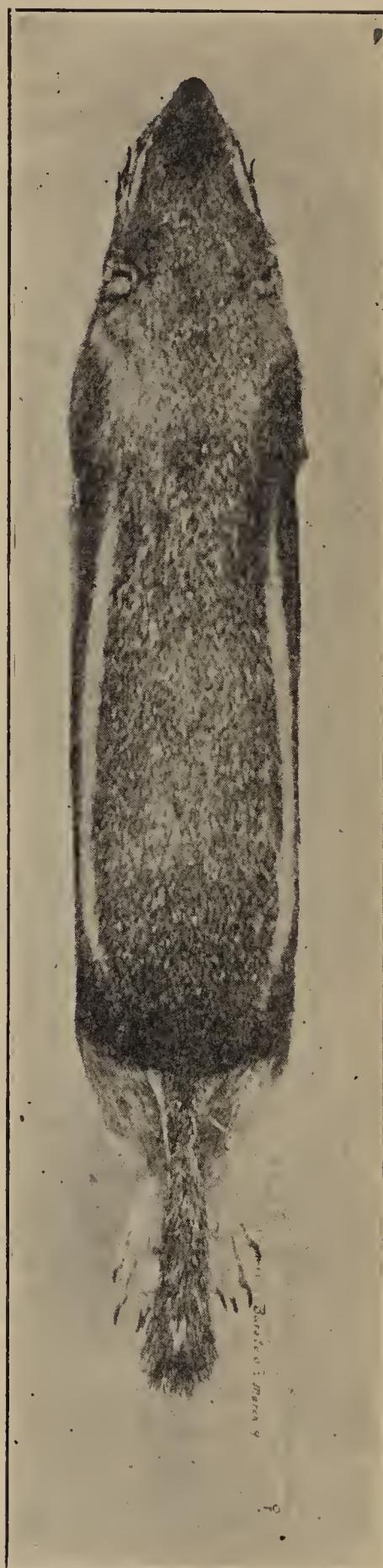


FIG. 2.—Sample of well-made mammal skin.

Each specimen should be fully labeled with carbon ink, and if to be carried far each should be wrapped in cheesecloth. After remaining for 5 to 10 days in formalin the specimens can be wrapped, packed in tin cans, and sent by mail.

TAKING NOTES.

A notebook and hard pencil should be carried in a convenient pocket, and in a new locality every mammal, bird, reptile, and characteristic plant seen should be recorded, not at the end of the day but when seen. Each day's notes should bear their own date and locality, and each note should be complete in itself. While traveling the notes should be especially full and complete, so that at the end of one or two weeks they may be included in the report for that

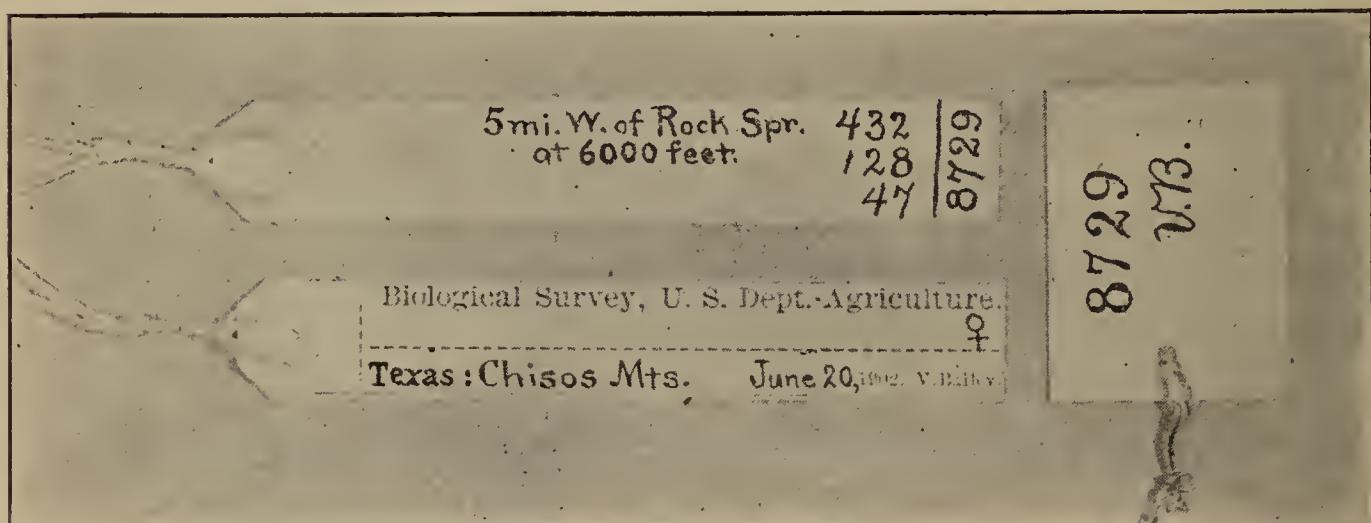


FIG. 3.—Sample skin label, back and front, and skull tag.

locality or series of localities. Reports made up from memory are worse than worthless.

Every specimen collected should add something to our knowledge of the habits and economic status of the species. Some knowledge of the kind of ground it occupies and of its surroundings, actions, and food is usually gained in procuring the animal. The external or internal cheek pouches of many species of rodents contain seeds, leaves, stems, or roots of plants which, if not recognized by the collector, should be saved and later identified. The contents of stomachs are the surest index to food habits, and the stomachs of birds and of many mammals should be examined or preserved in formalin for examination in the laboratory. Stomachs should be tagged and numbered and the data recorded on schedules. The contents of stomachs of large species examined in the field should be recorded on blank stomach cards or in the reports.

The numbers of embryos contained by females, with notes on their size, and date when found, show how prolific the species are and the seasons for breeding. In the case of many species full sets of embryos

should be saved in formalin. The breeding habits of birds are more easily studied than those of mammals, and notes on nests and eggs should be recorded. Every fact bearing on the habits, abundance, and distribution of a species should be noted at the time and later should be included in the report.

In going to and from the field and on trips from place to place many important notes on the distribution of species may be procured. Every locality where a prairie dog, a jack rabbit, or other recognizable mammal or bird is seen from the train should be recorded, and the note sent in under the locality heading. The distance and direction from a known locality should be given, also the date and, in high country, the altitude, if known. The beginning and termination of the range of any species of tree or conspicuous plant should be noted, and especially any species serving to mark the transition from one zone or one faunal area to another. Careful observations recorded during a railroad trip are often of great value.

LIFE ZONES.

The study of the distribution of species has for one practical object the determination of zone limits, or the limits of areas over which certain groups of species thrive. While latitude and altitude are the prime factors controlling the amount of heat which limits the range of species, there are so many other modifying influences that latitude and altitude alone are wholly inadequate guides to the zone limits. Some of the other factors are *base level, slope exposure, steepness of slopes, soil cover, burns, rainfall, snow, dryness, proximity to large bodies of water, color of soil, underground waters, underlying rocks, rising and falling air currents, and prevailing winds.*

Base level is a term applied to the mean elevation of an area of country, generally that adjoining mountains in contradistinction to sea level, from which altitude is usually reckoned. The life zones are usually carried higher by an elevated base level, such as is often found on the inland slope of a range of mountains, than on a slope beginning at sea level or at a low altitude.

Slope exposure, or the relation of a slope to the sun's rays, has a marked effect on the distribution of species, the greatest quantity of heat falling on the southwest slope and the least on the northeast. The same species usually ranges much higher on a warm southwest slope of a mountain than on a cold northeast slope. Therefore, in running zone lines the direction of slope should always be given, as well as the limits of range in altitude of each species.

The steeper the slope the greater the difference in the range of a species on its hot and cold faces, a steep mountain range or peak often giving a difference of 1,000 feet for the same species on its southwest

and northeast sides, while a gently sloping elevation may show a difference of a few hundred feet only. The steepness of a slope can in some cases be measured, but usually an approximate estimate is sufficient.

Soil cover, or character of vegetation, has a marked influence on the distribution of species and on the limits of zones. Deep forests or dense vegetation have a cooling effect, while barren soil or naked rocks carry species higher on south slopes if not lower on north slopes.

A burned area on a mountain side is often covered with plants from the zone below.

On a dry slope the zone limits usually run a little higher than on a corresponding moist slope.

Cold streams often carry along their banks species of plants and animals entirely through the next zone below that to which they normally belong.

Cold currents of air also flow down the bottoms of canyons and gulches on mountain sides, and in many cases, like cold streams, carry species far below their normal range on the open slopes.

The bottom of a small or narrow valley is usually so much colder at night than the sides that species belonging to a higher zone are often common there from 100 to 500 feet below their normal level.

By bearing in mind the modifying conditions above mentioned, zone limits may be determined with a fair degree of accuracy; otherwise, two adjoining zones may appear to overlap for their entire width and be hopelessly mixed.

IDENTIFYING ZONES.

Zones are characterized by groups of species of animals and plants having approximately the same vertical or latitudinal range. This grouping varies in different parts of the country, but in a general way has been determined across the continent of North America for each zone. In any region to be worked it is necessary to know some of the principal zone-determining species with which to coordinate the others that have the same range. Brief lists to start with can be furnished from the Biological Survey for any part of the country.

COLORING MAPS.

In the final reports for each locality the zones should be fully outlined and each described, but in addition they should be colored on the Geological Survey contour sheets or the best topographic maps available. Tropical should be red; Lower Sonoran, orange; Upper Sonoran, yellow; Transition, blue; Canadian, green; Hudsonian, pink; and Arctic Alpine, white.

Colored pencils are convenient for coloring the zones in these field maps.

FIELD REPORTS.

On the completion of work at each locality separate reports should be prepared on mammals, birds, and physiography, and in some cases also on reptiles, plants, and crops.

Sometimes two or more related localities where only a small amount of work has been done may be included in one report, but this should never be done in the case of localities from two States. It is always best to finish the reports for a locality before leaving it, but in cases of necessity they can be finished at the next locality as soon as possible and while the data are still fresh in mind.

The report should be made up from the daily notes, catalogue records, and the cards on which the examinations of stomachs have been recorded.

When there is doubt as to the identification of a species the specific name should be left blank or queried and followed by the catalogue numbers of one or more specimens, so that positive identification can be made later.

PHYSIOGRAPHY REPORTS.

At the beginning of a "Physiography Report" the exact location of the place where the work was done should be given. If the report covers several localities or a section of a continuous journey it should begin with a journal account of the trip under the heading "Itinerary," giving dates and time spent at each locality, means of conveyance, and all notes that will aid in a perfect understanding of the conditions. It is always important to know the route by which a place was reached.

Under the heading "General Features" should be given a description of the surface features of the country, including, if possible, altitudes, geological formations, soil, surface covering, water supply, and drainage.

Under "Life Zones" the plant and animal life should be treated.

If the area lies within one zone its characteristic species of plants, mammals, birds, and reptiles should be given. If two or more zones are included, the limits of each should be located by altitudes and horizontal distances on the various slopes, and the characteristic species for each zone enumerated under the proper headings.

MAMMAL REPORTS.

The report on mammals should include under each species notes on abundance, range, zonal position, habitat, habits, food, and especially notes of economic importance.

A list of generic names will be furnished by the Biological Survey as a guide to proper sequence of species in the reports.

BIRD REPORTS.

The report on birds should include under each species all notes on abundance, distribution (zonal and otherwise), habitat, migration, nesting, food and other habits, especially economic. The list of birds should follow the order of the A. O. U. Check List.

PLANT REPORTS.

Only in special regions is it necessary to prepare a separate report on plants, as most of the important species can be included in the physiography report under zone headings. In regions where great detail is required in zone work, or where the plants are not well known, a list of as many species as can be determined is desirable, with notes on abundance and distribution.

REPTILE REPORTS.

A separate report on reptiles is advisable where enough species are found to warrant it, as is usually the case in the Lower and Upper Sonoran Zones. In colder zones the species are so few that they may be enumerated under their zones in the physiography report.

CROP REPORTS.

So far as possible a list of the varieties of fruits, grains, and vegetables in each locality, or in each zone, should be given, with notes on their success and adaptation. Accurate data as to yield and quality should be obtained from the farmers wherever possible; also of injury to crops by frost, storms, drought, or animal pests.

FORM FOR FIELD REPORTS.

Uniformity in all field reports is important. Only the regular report paper (8 by 10½ inches) and good black ink of a standard make that will not fade should be used.

The following form of heading should be used for all field reports:

CALIFORNIA: Fresno, Tulare Co.

Mammals.

January 7 to 20, 1909.

William J. Smith.

Citellus beecheyi. Ground squirrels are abundant over open country and in the fields about Fresno.....

Thomomys pescalis. This pocket gopher is common in uncultivated parts of the valley where the soil is rich and mellow.....

Sylvilagus auduboni vallicola. Cottontails are now scarce, although at times they have been very numerous over the valley.....

